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Analysis of Implementing Multimedia Computing Systems for Training Applications within the United States Marine Corps

by

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tle *(include security classification)* ANALYSIS OF IMPLEMENTING MULTIMEDIA COMPUTING SYSTEMS FOR TRAININ
LICATIONS WITHIN THE UNITED STATES MARINE CORPS

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ABSTRACT

This is a study of implementing multimedia computing systems for training applications in the United States Marine Corps. Multimedia computing is the presentation of information combining text, graphics, audio, animation, and full-motion video. A brief review of multimedia technology is provided followed by its context within the Department of Defense, current use within the Marine Corps, and the role it can play in training Marines.

Multimedia training was found to be widely used throughout the Department of Defense and its use is supported by research study and policy directives. Current use within the Marine Corps was found to be minimal. Focus groups were conducted to examine why the Marine Corps' role is so limited and to discuss future implementation. Recommendations are provided for the Marine Corps to expand their use of multimedia as a means to augment conventional training methods.

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I. INTRODUCTION

Multimedia combines the audiovisual appeal of television and the interactive capability of the computer, it offers new ways to look at communications and information exchange. The computer no longer displays just text and graphics. Stereo sound, animation, and full-motion video are interactively controlled through a variety of input and output devices. This blending of technologies encourages the user to experience computing in a way that was never before available. By engaging multiple senses of sight, sound, and touch, reality is more closely modeled and user involvement enhanced. (IBM, 1991)

Multimedia technology is being applied in many areas such as teleconferencing, information kiosks, incorporation of audio and video clips in traditional computer documents, and as a tool to assist in training and education (IBM, 1991). Much work has been undertaken in this last area. It is a natural extension from earlier text based computer instruction. The addition of sound and video engages the learner's interest and the interactive interface offered by this technology closely mirrors the human thought process and encourages exploration and discovery (Amthor, 1992).

This paper will investigate the status of multimedia computing systems as applied to training applications in the United States Marine Corps (USMC)[1]. Discussion will center on the appropriateness of this technology, its context within the Department of Defense (DoD), current use within the USMC, and the role it can play in training Marines. Emphasis is on strategic implementation issues. The technology behind the power of multimedia is presented only as an overview. This will allow readers without a technical background to gain a basic understanding of the complexities involved without being overburdened with detail.

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[1] Refer to Appendix A for a complete list of abbreviations and acronyms.

Robert Mackissock of the Information Resources Management Office, Marine Corps Computer and Telecommunications Activity (MCCTA) indicates that there are approximately 23,350 IBM compatible personal computers (PC's) within the Marine Corps (Mackissock, electronic mail to author, April 1993). This thesis will focus on the IBM PC delivery platform. Training systems excluded will be full-scale simulators, courseware embedded in actual equipment, part-task training devices that require equipment besides the computer, mainframe systems, and virtual reality computing.

Several research methods were employed to gather data. A literature review, primarily focused on recently published articles, was conducted. Applicable military handbooks, standards, instructions, and orders were reviewed. Key personnel within industry, the DoD, and the USMC were interviewed by telephone. Focus groups, composed of Marine officers, were held to obtain additional qualitative data.

I. TECHNOLOGY OF MULTIMEDIA COMPUTING

A. MULTIMEDIA DEFINED

Multimedia computing is the presentation of information, by a computer system, that combines text, graphics, audio, animation, and full-motion video[2]. It is a blending of the audiovisual capabilities of television with the interactive power of computers. The interface typically allows for nonlinear intuitive navigation through an application to access information as needed. This is often accomplished using a touch screen or mouse. By stimulating multiple senses and creating personal interaction, interest and retention are enhanced. (IBM, 1991)

Current multimedia training applications are an outgrowth of earlier text-based computer instruction. When viewing multimedia in the context of training, it is important to understand other related terms. Computer-based Instruction (CBI) is any form of instruction in which a computer is used to enhance, deliver, or develop instruction. Computer-assisted Instruction (CAI) and Computer-managed Instruction (CMI) are subsets of CBI. CAI is a method of instruction in which a computer is used to present instruction. CMI uses the computer to manage instruction. Computer-based Training (CBT) includes CAI and CMI as well as computer simulation and part-task training. Interactive courseware (ICW) is characterized by the ability of an individual to respond to a computer program with an input device to control instructional presentations.[3] (TRADOC Regulation 351-16, 1991)

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[2] This definition and many others relating to multimedia computing, interactive courseware, and training are included in Appendix A.

[3] From these definitions, multimedia computer training can be considered to be both CBI and ICW. All ICW does not have to have multimedia capabilities. However, when ICW is used in this thesis, it is implied that ICW with multimedia capabilities is being discussed.

The key concept in multimedia is the ability to allow a user intuitive interaction with a computer system through aural and/or visual stimulation. Multimedia training does not always include every form of media in each application. There are many programs that contain animated graphics and sound but lack full-motion video. Rick Beger (telephone interview, 28 December 1992), a USMC project manager at the Naval Training Systems Center (NTSC), indicated that animated graphics is often preferable over full-motion video because of reduced cost and ability to depict sequences of events that video cannot capture.

B. COMPONENTS OF A MULTIMEDIA COMPUTING SYSTEM

When building a system, special consideration must be given to the unique aspects associated with multimedia computing. Optimal delivery requires fast processors, large amounts of random access memory (RAM), enhanced graphics capabilities, and significant data storage capability. The following components make up a multimedia system[4]:

- Computer
- Keyboard
- Graphics video card
- Video monitor
- Floppy disk drive
- Hard disk drive
- Videodisc player
- Compact Disc-Read Only Memory (CD-ROM) player
- Audio board
- Speakers or headphones
- Microphones
- Video capture and playback cards for full-motion video
- Input devices such as a mouse, joystick, or touch screen monitor
- Network interface card
- Modem
- Printer
- Software programs

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[4] All components listed are not required for every system. Examples of several standard delivery platforms are discussed later in this chapter.

C. DATA STORAGE

The addition of animated graphics, sound, and full-motion video significantly increases the amount of data required to make multimedia systems functional. Digitized high quality audio can require 88 kilobyte per second and digitized video can require up to 30 megabytes per second (Davies and Nicol, 1991). Even after compression techniques are applied, 60 minutes of video can require 550 megabytes of disk space (Quain, 1992a). Such demands for data storage quickly make most hard disks inadequate. A solution is the use of either CD-ROM or laser videodisc.

1. CD-ROM

CD-ROM's are similar in appearance to CD-Digital Audio (CD-DA) discs that are so popular in the recording industry. CD-ROM's have the advantage of storing any type of digital data to include text, graphics, audio, and video. The 4.75 inch discs have over a 600 Megabyte capacity making them ideal for multimedia applications. All data is digitally encoded on disc and can be randomly accessed using a laser in the CD-ROM player. (Amthor, 1992b)

The current generation of CD-ROM players has some restrictions. These include slow access times and low transfer rates. Typical access time averages 325 to 380 milliseconds (hard disk drives are frequently 20 milliseconds or less) with transfer rates at 150 kilobytes per second. Some newer players are appearing with access times of 265 to 280 milliseconds and transfer rates of 300 kilobytes per second. Another restriction is the conflicting number of competing formats. The basic format for DOS based CD-ROM's is the International Standards Organization (ISO) 9660 specification. This covers the logical structure and file format and ensures any disc manufactured to this standard can be played on a CD-ROM drive meeting the same specifications. From there, vendors have established their own standards, which have different purposes, to include CD-ROM Extended Architecture (CD-ROM XA), CD-ROM Digital Video Interactive (CD-DVI), and CD-Interactive (CD-I)[5]. Compatibility among formats is not guaranteed and no one

[5]Refer to Appendix A for more discussion of these formats.

format has yet established dominance. Finally, many CD-ROM applications do not currently provide high resolution full-motion video comparable to commercial television. (Quain, 1992a)

Despite these limitations, CD-ROM is the preferred choice for future multimedia systems. Many industry standard platforms already require that a CD-ROM drive be included. The reasons are the advantage of working with digital data, large storage space, the low cost of producing discs, and the ISO 9660 standard. In addition, CD-ROM players have the advantage of working with applications besides multimedia such as mass storage and retrieval systems. As this technology matures, it will replace the older analog-based videodisc player.

2. Videodisc Player

Videodiscs or laserdiscs predate CD-ROM as a storage medium. It uses a similar laser technology to read data. The difference is that videodiscs employ analog vice digital encoding. Video is stored on frames on the disc. A 12 inch disc can hold 54,000 images and provide up to 30 minutes of full-motion video and audio per side. Multimedia discs utilize the Constant Angular Velocity (CAV) format which allows for search capabilities, freeze frame, and other special effects. In contrast, home entertainment discs use the Constant Linear Velocity (CLV) format that doubles playing time but does not allow for many of CAV's functions. (Floyd, 1991)

The advantage of analog storage is superior video quality. It is comparable to that of television broadcasts. The disadvantage is that analog data cannot yet be further processed by the computer or transferred over digital networks. With the future of computer training programs relying more and more on these capabilities, laserdisc technology will eventually be replaced by CD-ROM or some other digital format.

There are many military training applications that employ laserdiscs and it is a widely accepted standard within DoD. Interactive Videodisc (IVD) instruction accounts for the majority of all multimedia programs currently available. Gary Boycon, Director, Training Systems and Technology, Office Assistant Secretary Defense, Force Management

and Personnel (telephone interview, 29 January 1993) indicated digital technology has only recently matured to the point where DoD has begun to consider it as the best alternative.

D. AUDIO

Audio is an important part of multimedia. By providing sound, training applications become more realistic. For example, instead of explaining how an improperly tuned vehicle sounds, audio clips of actual engines displaying this characteristic can be played. The user will receive a more precise and engaging learning experience. Laserdiscs provide audio in analog format. There are several forms of digitized audio.

1. CD-Audio

CD-Audio has the same format and quality as the disks that are played in CD players at home. CD-ROM players will play conventional CD's. CD-Audio and data can be mixed on a CD-ROM disc, but current standards will not allow audio to be played if other data is being accessed. (Petzold, 1992)

2. Waveform Audio

Waveform audio is stored in a format that a computer can interpret and manipulate. This allows sounds to be captured with a microphone, converted, and then stored and accessed like other computer files. Microsoft® Windows™ uses a sampling technique know as Pulse Code Modulation to accomplish this. As sampling rate and sample size are increased, audio quality is improved. The tradeoffs are more expensive hardware and larger file size. Since this format does not yet support compression, one minute of CD-quality sound requires 10.5 Megabytes of storage. (Petzold, 1992)

3. Musical Instrument Digital Interface (MIDI)

MIDI music is generated by a computer and compatible audio board from a selection of preset sounds. MIDI files can be prerecorded and incorporated into multimedia applications as background music. There are several advantages to this format. Principally, it requires limited storage space. Thirty minutes of stereo music needs only 200 kilobytes. This would require over 300 Megabytes if the previously

discussed formats were used. You can also play MIDI simultaneously with waveform. This allows the incorporation of speech and music. MIDI has existed for almost ten years and there are a large number of existing files available. The disadvantages include more expensive hardware for high quality sound and some incompatibilities between sounds produced by different synthesizers. (Hendall, 1992)

E. IMAGE COMPRESSION AND DECOMPRESSION

To handle large data files required of multimedia applications, compression technology must be applied. This will be key in replacing analog video and in allowing data to be distributed over networks. There are a number of compression techniques that are currently under development to address this issue.

Compression comes in two forms. Lossless, which is used primarily for text, eliminates redundancy and causes no loss in data integrity. This technique, which only achieves a 2:1 compression ratio, is inadequate for multimedia. Lossy techniques sacrifice information for compactness. Using specialized procedures to process complex math computations and coding steps, redundant data is compacted and visually imperceptible picture components are discarded. With compression ratios up to 200:1, this method is acceptable for multimedia applications. (Kubulins, 1992)

1. Joint Photographic Experts Group (JPEG)

JPEG was developed in the 1980's to provide a standard for still images. It has been adopted by the Consultative Committee for Telephony and Telegraphy (CCITT), ISO, and has wide market acceptance. JPEG is symmetrical. This allows the same algorithms to handle both decompression and compression. Compression rates range from 8:1 to 75:1. As compression ratios increase, there is degradation in the quality of image. Although JPEG is intended primarily for still frame applications, several companies are applying this technology to full-motion video until other standards are finalized. (Kubulins, 1992)

2. CCITT H.261

CCITT H.261 standard, also known as Px64, was optimized to achieve very high compression ratios for full-color, real-time motion video transmission. Its principle application is teleconferencing. Px64 sacrifices resolution for near instant transmission and display. Because video-based telecommunications are usually not motion-intensive, this standard can achieve results ranging from 100:1 to over 2000:1. The tradeoff is annoying visual effects, such as poor resolution and jerking pictures, when excessive motion is present. (Kubulins, 1992)

3. Motion Pictures Experts Group (MPEG)

MPEG was created to meet the need for higher quality full-motion video. MPEG is two to three times more effective than JPEG. Compression ratios range from 50:1 up to 200:1, but quality may diminish over 50:1. MPEG is asymmetrical. This means different algorithms as well as varying times are needed for compression and decompression. MPEG is optimized for motion-intensive video applications and can give entertainment quality video. MPEG is targeted at digital storage media such as CD-ROM. (Kubulins, 1992)

4. Digital Video Interactive (DVI®)

DVI is a proprietary format marketed by Intel®. It comes in two types which are Real-time video (RTV) and Production-level video (PLV). RTV can be created on your desktop and has average compression ratios of 20:1. PLV's compression ratios are 100:1 with higher resolutions than RTV. The major drawback is PLV video must be sent to Intel or a service bureau for mastering on a mainframe computer at cost of $200 per minute. Once compressed, PLV can be played back from a CD-ROM using low cost hardware. With anticipated strong market acceptance of MPEG and Intel's own intent to support it in future DVI processors, the proprietary nature of DVI places the basis of a standard upon it in question. (Kubulins, 1992)

5. Software Architecture Supporting Compression

Until recently, DVI was one of the few choices offered for developing applications with digital video. Now more vendors are applying various compression techniques previously discussed. For example, Apple's® QuickTime® and Microsoft's Audio-Video Interleaved (AVI) have been introduced. The dilemma is that many of these applications do not offer the quality and resolution users have come to expect from commercial television. Jerky pictures and images limited to quarter screen are common problems. These are being resolved and will eventually disappear as the technology matures. Even with minor flaws, current digital video is quite acceptable for many applications. It also represents the future for multimedia and will eventually replace analog applications. (Kubulins, 1992)

F. DISTRIBUTED MULTIMEDIA COMPUTING

For multimedia to reach its potential, it must expand beyond stand-alone technology. Current trends indicate that applications need to be networked so they can reach a larger target audience within an organization. Because of the huge storage requirements of multimedia applications, it would be advantageous to maintain data on a central server and allow access as needed. The transfer of this amount of data can bring most current network technology to a standstill. In addition, data must arrive in a continuous stream so it makes sense to the user. This requires a combination of bandwidth and real-time delivery. The compression techniques previously discussed are essential to reduce the size of files moving across networks. The problem created by using compression techniques is bursty traffic. Several options are being developed to provide a means of effectively transmitting multimedia.

Fiber Distributed Data Interface (FDDI) allows for 100 megabyte per second bandwidth and is a good choice because it has been adapted to less expensive twisted-pair cabling. However, this option is still relatively expensive when compared to Ethernet or Token-Ring and is not widely available today. Another disadvantage is that FDDI does not support isochronous or real-time data transfer. This is important if motion video is to

maintain a natural jerk free look. One enhancement to this standard is FDDI II that will deliver isochronous transmission. This standard is currently being formulated by the ANSI X3T9.5 Committee and is not yet available. (Raymond, 1992)

Several new technologies are being developed that offer isochronous communications at rates of more than 100 megabytes per second. One is the Asynchronous Transfer Mode (ATM) that is well suited for carrying audio, data, and video traffic by guaranteeing applications a fixed response time. It uses a form of fast-packet switching that allocates 53-byte fixed-length frames. ATM is also consistent with Broadband Integrated Services Digital Networks (B-ISDNs) which will allow for both Local Area Networks (LANs) and Wide Area Networks (WANs) to be seamlessly linked. (Raymond, 1992)

Finally, there is FDDI Follow-on (FFOL). This will allow for LAN technology that exceeds transfer rates of over one gigabit. The target date for publication of these standards is 1995. One of the key features of these LANs will be the ability to carry multimedia compressed digital video traffic. (Raymond, 1992)

While awaiting further enhancements to FDDI and the arrival of ATM and gigabit LAN technology, users planning to adopt multimedia should begin laying the network structure to support such technology today. This calls for establishing backbones that rely on fiber optic cabling. With such backbones in place, distributed multimedia can be economically and easily implemented as the technology matures.

G. DELIVERY PLATFORMS

Multimedia can be delivered on a variety of platforms including Apple's Macintosh®, Commodore's Amiga®, UNIX workstations, as well as IBM compatible personal computers. Existing computers can be upgraded to support multimedia or systems can be purchased that are fully multimedia capable. Two IBM compatible standards will be discussed.

The Multimedia PC Marketing Council, Inc. was established to encourage the use of standard multimedia computing platforms[6]. Users can be assured that software bearing

[6]The Council is a subsidiary of the nonprofit Software Publisher's Association.

the MPC trademark will work on MPC licensed systems or upgrade kits. The following are minimum system requirements for the MPC specification 1.0: (Multimedia PC Marketing Council,1992)

- 386SX (or compatible) microprocessor
- Two megabytes of RAM
- 3.5" high density (1.44 megabyte) floppy disk drive
- 30 megabyte hard drive
- CD-ROM drive with Red Book outputs, front panel volume control, sustained 150 kilobyte per second transfer rate without consuming more than 40% of the CPU bandwidth and one second average seek time
- Audio board with 8-bit Digital-to-Analog Converter (DAC) and 8-bit Analog-to-Digital Converter (ADC), music synthesizer, and on board analog audio mixing
- VGA graphics adapter with compatible monitor
- 101 key keyboard
- Two button mouse
- Serial port, parallel port, MIDI I/O port, joystick port

This system is considered minimally acceptable and many robust applications will run in a degraded fashion. It is anticipated that systems requirements will be increased to keep pace with advances in the industry. Companies who are members of the council are free to develop technology that does not meet this standard. However, these products do not receive the MPC logo.

IBM chose not to be a member of the council and established their own standard called Ultimedia™. The basic configuration offers considerable improvement over that of MPC. It includes the following: (Jones, 1992)

- 386SX 20 MHz processor with 8 kilobyte internal cache
- Four megabyte of RAM
- 16-bit XGA adapter
- 80 megabyte hard drive
- CD-ROM XA drive
- 16-bit M-Audio Capture and Playback Adapter/A
- Enhanced internal speaker
- 3 operating systems (MS-DOS® 5.0, OS/2 2.0®, and Microsoft Windows 3.0)
- Options include touch screen monitors, cable-ready television adapters, and DVI compression and decompression technology.

Vendors are developing or adapting multimedia technology for their own systems. The market has just begun to take off. Multimedia will be one of the key technologies influencing how we use computers. In the future, high-resolution graphics, video, and sound will be standard features of all machines and applications. (Miller, 1992)

III. MULTIMEDIA AND MILITARY TRAINING APPLICATIONS

A. BACKGROUND

Training within the military is ultimately linked to national security and DoD strategic objectives. It is a vast undertaking and total funding appropriated for individual training and education for Fiscal Year 1993 within DoD is approximately $14,700,000,000 (MMTR, 1992)[7]. It is also very complex to accomplish (Fletcher, 1990). With the end of the Cold War and emphasis on domestic economic issues, military leaders are searching for ways to train in an atmosphere of downsizing, reduced budgets, and base closures. At the same time, military systems have grown more numerous and sophisticated and require better trained personnel to ensure their proper operation and maintenance (Fletcher, 1990). Even basic infantrymen carry laser targeting devices and frequency hopping radios. Costs for fuel and ammunition continue to rise (Fletcher, 1990). Base closures, environmental concerns, and sensitivity to the use of overseas locations limit areas where training can be conducted. Difficulties arise as to how best to train units that are widely dispersed, autonomous, or part of the Reserves or National Guard (Fletcher, 1990). All these reasons point to a need for innovative training methods.

B. UTILIZATION

The challenge is to find approaches to maximize resources available for training. Multimedia is one alternative that can be used. However, it is not a panacea for all training problems. Understanding when it can and should be employed and what benefits will be derived are crucial for successful implementation. Wright (1993) provides the following scenarios, taken in part or whole, when multimedia may be appropriate:

- Target audience is large and must be trained repeatedly.

[7]The Military Manpower Training Report defines "individual training" as training conducted by individual military members in formal courses conducted by organizations whose primary mission is training. It excludes all training conducted by operational units and on-the-job training.

- Target audience is widely scattered and it is not cost effective or possible to have them travel to a central training location.
- Students in a class have diverse skills, proficiency levels, or learning styles.
- Content is relatively stable and wholesale changes are not foreseeable.
- Content or consistency in delivery is so critical that it must be carefully controlled for accuracy or correct interpretation.
- Content is too dangerous for novices to participate in and multimedia simulation will allow for practice and confidence building prior to the actual situation.
- The actual situation cannot be undertaken beforehand and must be simulated in rehearsals.
- Scheduling difficulties arise because the student cannot take extended time from other critical missions to attend a normally conducted training program.
- The expense of conducting live training is cost prohibitive.
- There are a limited number of qualified trainers.

C. BENEFITS

All scenarios described above apply to many training situations within the USMC. The question arises as to whether it would be beneficial to do so. There have been studies conducted on the merits of multimedia training in comparison to conventional training. The one deemed most appropriate for inclusion in this paper was conducted by Fletcher (1990) in response to Congressional inquiry concerning the use of interactive videodisc technology within DoD. It was chosen not only for its applicability to DoD, but also because it is widely referenced in the literature.

The study's purpose was to determine the effectiveness, cost-effectiveness, time on task, retention, and overall applicability of IVD to current and future DoD training requirements. Fletcher's methodology involved a quantitative, analytic review, termed a meta-analysis[8]. Empirical evaluation studies comparing IVD with conventional training were taken from the military, industry, and higher education. A summary of the key findings is provided:

- IVD instruction was more effective than conventional instruction in military training.
- IVD was equally effective for both knowledge and performance outcomes.
- The more the interactive features of IVD were used the more effective the resulting instruction.

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[8] Details concerning this methodology are provided in Fletcher's paper.

- Directed tutorial approaches were more effective than stand-alone simulations in IVD. In other words, IVD is more effective when incorporated into a complete training system than when they are used as a stand-alone resource.
- Within-group variability of achievement was smaller in IVD than in conventional instruction. In other words, fewer students are left behind.
- The effectiveness of IVD was greater than computer-based instruction without interaction.
- IVD was less costly than conventional instruction. This was largely based on the fact that hardware and simulation software took the place of actual equipment in training. The caveat was made that specific cost savings would need to be determined on a case-by-case basis.
- By using IVD, the average time saved in reaching criterion levels of achievement in instruction was 31 percent. This translates into a benefit by allowing military personnel to return to their assigned duties more quickly. If viewed in terms of pay and allowances, it can be judged as another source of cost savings.
- The combination of reduced costs and more effective results suggest that IVD may be the most cost-effective alternative for many applications[9].
- IVD may increase the student's willingness to spend time practicing a targeted task over conventional instruction[10].
- IVD seems unlikely to effect retention.

Fletcher concluded that IVD is both more effective and less costly than conventional instruction and recommended that it routinely be considered and used in military training. The caveat was made that systems providing the same functionality as IVD, such as digital video, digital audio, and CD-ROM, may achieve at least the same effectiveness. This study was completed in 1990. When contacted as part of this thesis research, Fletcher (telephone interview, 23 December 1992) indicated that the results of the study remain valid and are applicable to current digital technology and CD-ROM applications .

One of the key factors in deciding to employ multimedia will be economic viability (Brandt, 1987). Fletcher's (1990) study indicated that there are cost savings associated

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[9]Fletcher viewed this result as suggestive rather than conclusive because none of the reviewed studies examined both cost and effectiveness in a properly controlled empirical study based on a systematic model of cost inputs and effectiveness outputs.

[10]Fletcher's analysis found that students enjoyed IVD instruction, would recommend it to others, and found it easy to use. This suggests they might be willing to spend more time on relevant instruction tasks. Only one reviewed study had quantitative data on this issue and it reflected a 45 percent increase in the time students were willingly to spend training using IVD. Fletcher also viewed this as promising but not conclusive.

with the use of IVD. Brandt (1987) provides detailed guidelines for conducting a cost-benefit analysis for videodisc training. This study indicates that IVD training will initially be more expensive in development than conventional training. This centers on the fact that computer hardware must be purchased or upgraded and courseware developed. However, during the delivery and maintenance phases IVD training costs are significantly lower than conventional training. This is because savings are obtained in travel costs, reduced instructors, administration, training materials, and equipment[11]. When an entire life cycle is considered, IVD training will often be more economical than conventional training. As more students utilize an IVD training program, the cost per student becomes lower and lower.[12]

D. LIMITATIONS

There are tradeoffs when employing multimedia technology. As discussed above, even though multimedia may be more economical for an entire life cycle, it requires large outlays of capital during development. In the current budgetary climate, such funds could be difficult to obtain or be approved in a Program Objective Memorandum (POM) initiative.

Because of the time and money invested in the development of courseware, it is not good for training environments where there are frequent changes in course content. A program of instruction has to be relatively stable to qualify as a candidate for multimedia (Wright, 1993). In addition, computer software can not yet take the place of a human instructor. Even though programs are interactive, they cannot answer every possible question. Students who are having difficulty or the aggressive student who desires more information may become frustrated if help is not available. Depending on the training

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[11] Actual savings are situation dependent, e.g., number of instructors involved, salary levels, distance to travel, type of materials and equipment used, etc. Brandt (1987) provides numerous formulas to plug in these type of factors so that potential savings can be computed.

[12] The intent of this thesis is not to provide detailed guidelines on economic analysis. It is recommended that other references be consulted on this issue.

scenario, this may require that a limited number of instructors be available to handle these situations.

Students who need to receive repetitive refresher training in one particular subject may become bored with completing the same multimedia course over and over. This is analogous to renting a videotape. No matter how good it was the first time, everyone quickly reaches a saturation point where it can no longer be watched. In such cases, additional multimedia modules would have to be developed.

To be successful, one must know when multimedia is appropriate and what the potential benefits are (Wright, 1993). There are certain things that are just not right for this technology. For example, participating in a field march with pack and rifle or navigating with map and compass across rough terrain are best experienced in real life rather than in front of a computer.

E. STRATEGIC THINKING

Proper implementation of multimedia requires strategic thinking and long range vision. When comparing costs, benefits, and limitations, the goals of an organization must be considered. Multimedia will most likely be initially reviewed in terms of funds allocated and a return on investment. However, thinking should not be limited to monetary concerns. Other benefits should be computed. Considerations such as better trained personnel, availability of courses that couldn't previously be provided, and the ability to offer training around almost any schedule should be included for consideration in the planning process. (Comocowich, 1992)

Multimedia is often best at doing things that other forms of training cannot accomplish (Commocowich, 1992). Innovative leaders will be able to find solutions to difficult training problems. The key will be to choose places to implement the technology so effort and money will not be wasted in inappropriate areas. Both effectiveness and efficiency will have to be taken into account. An initial successful implementation can set the tone for future acceptance of other applications.

As with all aspects of computing, fighting obsolescence by chasing after the latest technology can be self-defeating. Emphasis should be on course content and application design not on the latest and greatest hardware available to deliver it. Mr. Kent Thomas of Allen Communications (telephone interview, 22 December 1992) indicated that quality courseware should be the priority because only quality applications will stand the test of time and will be able to transition as delivery platforms are upgraded or changed.

Finally, process improvement and re-engineering must be accomplished before converting existing conventional training to multimedia. If a course is not already a solid and valid instructional tool, turning it into a multimedia version will not make it so. A multimedia course, based on a poor conventional course, won't work. It will require large expenditures of time and money to make it work.

IV. MULTIMEDIA TRAINING WITHIN DOD

A. BACKGROUND

DoD is the biggest customer of multimedia technology (Payne, 1991). The primary users to date have been the Army, Air Force, and Navy. The Marine Corps has played a minor role. The use of multimedia is well established and accepted as a viable training alternative. By 1995, DoD multimedia purchases are expected to reach $896, 000, 000 (Demott, 1992). In an environment of downsizing and budget cuts, multimedia as a training alternative will likely increase.

Gary Boycon (telephone interview, 29 January 1993), Director, Training Systems and Technology, Office Assistant Secretary Defense, Force Management and Personnel and a member of the DoD Advisory Group on Interactive Courseware (DAGIC) provided the following overview of multimedia training:

- Multimedia training is well established within DoD and is widely recognized as a viable and important training tool.
- DoD is currently working with organizations such as the Interactive Multimedia Association (IMA), the National Institute for Standards and Technology (NIST), and industry to encourage standardization of the technology.
- The transition from interactive videodisc to digital audio, digital video, and CD-ROM is a natural progression. DAGIC is currently studying ways to implement and standardize this technology across all Services.
- There is increased emphasis for all services within DoD to work together to ensure that issues such as standards, portability, and interoperability are met regarding multimedia training applications.

B. GUIDELINES

The following documents provide policy and technical guidelines for the management of ICW within DoD.

1. MIL-STD-1379D

Military standards are intended as tools for military acquisition and provide guidance on processes, procedures, practices and methods. MIL-STD-1379D (1990),

Military Training Programs, is the principal DoD standard for training. It establishes procedures to follow when developing and documenting training programs and contract requirements. There are four appendices included. Appendix A provides rationale and guidance for the selection and tailoring of military training program tasks. Appendix B provides an overview of the ICW development process and a matrix of ICW development products, deliverables and supporting task descriptions. Appendix C facilitates implementation of the Computer-aided Acquisition and Logistic Support (CALS) requirements for the acquisition and delivery of training data. Appendix D contains requirements for software interfaces and related commands to ensure ICW and authoring systems portability on interactive video delivery systems.

2. DoD Instruction 1322.20

DoDI 1322.20 (1991), *Development and Management of Interactive Courseware for Military Training*, has three purposes:

- The establishment of policy, responsibilities, procedures, and requirements for the development and management of ICW for training military personnel.
- The establishment of DAGIC whose mission is to monitor and update ICW standards to keep them current with advances in technology.
- The promotion of cost-effective use of ICW.

This instruction applies to all ICW developed by or for the DoD. It excludes full-scale simulators, part-task training devices in which actual equipment or simulated equipment not integral to the courseware is required for performance, and computer controlled training embedded in actual equipment.

DoDI 1322.20 sets five policies for the development and management of DoD interactive courseware programs:

- ICW programs are to be designed to promote portability.
- The Government shall not agree to payment of royalties, recurring license, or run-time fees, use taxes, or similar additional payments for ICW, associated presentation materials necessary to interpret and execute the courseware, documentation, or associated training material for ICW programs.
- The Defense Instructional Technology Information System (DITIS) is established to provide an inventory and maintain a catalog of DoD ICW programs for use by all DoD components. This database will be checked before development to see if a similar program can be used or modified.

- Reproduction master materials must be archived for the life cycle of each ICW program.
- DoD components must ensure the availability of all materials necessary to modify ICW programs throughout their life cycles.

Per DoDI 1322.20, when developing ICW, a comprehensive analysis of the total training systems requirement and media selection analysis is to be conducted to determine if its use is an effective and efficient means for presenting training materials when compared to other options. Prototype ICW programs will be validated in the actual training environment and discrepancies corrected prior to acceptance, distribution, and use. Reusability will be practiced by first reviewing the DITIS database to determine if existing products meet or can be cost effectively modified to meet new training needs.

a. Defense Instructional Technology Information System (DITIS)

Established by DoDI 1322.20 and implemented in 1991, DITIS is designed to facilitate resource sharing within the DoD. To accomplish this, the DITIS database provides an automated, on-line catalog of ICW programs used in military training. In addition, it provides information on all DoD owned ICW programs, whether fielded or under development. Interaction with DITIS is required when an ICW program is proposed, under development, completed, revised, and terminated. Data entry may be submitted using automated computer software or manually via mail. The developer enters the target audience who will benefit by the courseware. Initial data must be placed in the database within 30 days following component approval to develop or fund the courseware. The referenced instruction provides detailed guidelines on the format for submission.

b. Portability

A key provision of DoDI 1322.20 is the requirement for ICW to be portable. Fletcher (1992) conducted a detailed study of the implementation of this policy. He found the following key points[13]. Portability is the ability to operate the same software across many different computer platforms. Without portability, routine exchange of ICW

[13] The intent is to provide a brief overview so that readers will have a basic understanding of this topic. For those desiring more detail, a review of Fletcher's (1992) study is recommended.

would not be possible. Portability is currently being accomplished using a specification known as virtual device interface (VDI) that places a layer of software between the ICW program and the operating system of the computer. This allows ICW applications to move among hardware platforms and operating systems without reprogramming. The portability initiative will allow for exchange of programs throughout DoD. Since there are similar training requirements in many areas of DoD, this will allow for onetime development of a course for multiple service use. For example, the Marine Corps and Army could both benefit by courses on maintenance procedures for the many pieces of equipment held in common. Portability will result in lower per-unit costs for ICW, lower systems development costs, and increased efficiency for DoD.

3. MIL-HDBK-284

Military handbooks provide general information, technical data, and processes associated with design, engineering, production, acquisition, and supply management matters. Specifically, MIL-HDBK-284 (1992) provides guidance on ICW and is published in three parts. MIL-HDBK-284-1, *Manager's Guide for Development, Acquisition, and Management of Interactive Courseware for Military Training*, is designed to assist new or prospective DoD program managers and training systems users in understanding acquisition and management requirements for the procurement of ICW using MIL-STD-1379D. It covers training analysis, design, development, acquisition, and management of ICW for military training. MIL-HDBK-284-2, *Portability Practices for Interactive Courseware for Military Training*, is used with MIL-STD-1379D to establish and implement portability protocols. MIL-HDBK-284-3, *Glossary for Interactive Courseware for Military Training*, contains definitions of key terms, abbreviations, and acronyms related to military training and ICW.

C. FORUMS

DoDI 1322.20 established DAGIC to monitor and update ICW standards and to keep current with advances in technology. This group is composed of representatives from the Defense Department, each separate service, and Defense Agencies. It provides a forum to

discuss initiatives of each service and to determine the direction ICW should take within DoD. This includes liaison with the IMA, NIST, and industry. Considerable emphasis is placed on portability requirements and interoperability.

Another forum, that is chartered by and responsible to DAGIC, is the Joint Service Action Group (JSAG). JSAG develops and coordinates inputs from functional users in areas such as design, development, costing, acquisition, implementation, and life-cycle support of ICW. It is composed of members from each service and meets on a quarterly basis. JSAG's work includes updates to MIL-STD-1379D and writing portions of MIL-HDBK-284.[14]

D. ACQUISITIONS AND CONTRACTING

DoDI 1322.20, MIL-STD-1379D, and MIL-HDBK-284 provide guidance on acquisition and contract issues. JASG is also involved on an ongoing basis with standards and other issues that impact this area. Individual services can use this published guidance and the JASG forum to establish contracting procedures for multimedia applications.

As a long time user of multimedia technology, the U. S. Army has already taken the initiative in this area. Their Training Support Center (USATSC) is currently working with TRADOC Contracting Command (TCA) to award three multimedia contracts (MMC) in early 1993. The MMC will be open to all DoD components to support their training requirements. A partial list of what the MMC contains is courseware for interactive videodisc, courseware for CD-ROM, CD-Interactive, and DVI, and training analysis and development packages. All material will be designed, developed, and produced per MIL-STD-1379D and DoDI 1322.20. The MMC will have a five year ordering period from Fiscal Year 1993 to 1997. Characteristics include best value award, firm fixed price, and delivery ordering processing. MMC allows users to order training material through a qualified and experienced contracting agency. (TRADOC Multimedia Handbook, 1992)

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[14] LtCol McLyman and Margie White from the Training and Education Division at Quantico, Virginia are the current USMC DAGIC representatives and Rick Beger, USMC Projects Office, NTSC at Orlando, Florida is the USMC JSAG representative.

V. STATUS OF MULTIMEDIA TRAINING IN THE USMC

A. CURRENT APPLICATIONS

An investigation to determine the Marine Corps' use of multimedia for training applications was conducted. It involved an extensive number of phone calls and exchanges of correspondence using the Marine Corps' Electronic Mail System (ELMS). While not exhaustive, it did include contacts with many key personnel[15]. The conclusion is that there is currently limited use of multimedia computing to support training applications within the Marine Corps. Lieutenant Colonel McLyman (telephone interview, 22 February 1993), Head, Training Management and Education Section at Quantico, Virginia indicated all development is ad hoc by local commands with only loose adherence to the DoD standards discussed in Chapter IV and there are no Marine Corps wide multimedia training applications.

Although not designed specifically for training, one application that is receiving Marine Corps wide distribution and does have elements of multimedia is the CD-ROM disc, *"A Line in the Sand."* This disc contains information concerning USMC participation in Operations Desert Shield and Desert Storm and was designed as a reference tool. It includes many graphical images and several audio tracks. An interface, using a hypertext search capability, provides interaction with the program. Though a very rudimentary use of multimedia capabilities, it does illustrate some potential of the technology in a forum that should interest many Marines[16].

[15] Personnel were contacted at C4I2 and Manpower at Headquarters Marine Corps (HQMC), Training and Education Division and Warfighting Development and Integration Division at the Marine Corps Combat and Development Command (MCCDC), Marine Corps Institute, Computer Science School, Communications Electronics School, Personnel Administration School, Marine Corps Computer and Telecommunications Activity, and the Naval Training Systems Center.

[16] Questions concerning the distribution of *"A Line in the Sand"* can be directed to the Warfighting Development Integration Division in Quantico, Virginia.

Although no robust multimedia training applications could be found, there is interest in developing this technology. Many people who were contacted had heard about multimedia, had seen a demonstration, or owned a personal multimedia system. Several organizations such as the Marine Corps Institute are looking at the feasibility of adopting it in selected areas and formal schools are experimenting with ways to include it in their curriculums.

B. OBJECTIONS TO IMPLEMENTATION

As a result of finding so few multimedia development projects in the Marine Corps, the investigation was expanded to find the reasons. Lieutenant Colonel McLyman's office coordinates all ICW for the Marine Corps. He (telephone interview, 22 February 1993) indicated that there is very little ICW development occurring in the Marine Corps. In addition, what is being done is ad hoc and often of poor quality in terms of either following a systems approach to training and/or in using the technology itself. One of the biggest obstacles is a lack of research and development money to fund implementation properly. Another major reason was the lack of infrastructure in the Marine Corps to support development. Unlike other Services, that have a career track with military and civilian personnel dedicated to the acquisition, development, and management of ICW, the Marine Corps has less than a dozen people involved in this area and the people who are involved do not do it as a primary function.

Margie White (telephone interview, 30 December 1992), an Instructional Systems Specialist, works for LtCol McLyman and is the principal action officer for ICW. She previously worked with the Army in their ICW programs and provided the following reasons for the current lack of USMC development and use:

- There is a high cost of initially purchasing equipment.
- There is a high cost of developing courseware.
- There is general lack of knowledge about strengths and limitations of the technology.
- There has never been a top level champion for this type of training.
- Local commands who have initiated multimedia development on their own are reluctant to share this with MCCDC or HQMC because of fear that their efforts may be stopped or changed in a direction they do not want.

- There is a reluctance by some within the Marine Corps to utilize courseware developed by other services because they feel it may not take into account the requirements needed to properly train Marines.

Captain Kirk Skinner (telephone interview, 7 January 1993) from the Automated Information Systems Branch within the Training and Education Division provided these additional reasons:

- There is a concern that any training tied to computer technology could become invalid as technology grows obsolete.
- There is concern within the training establishment that computers could replace people.
- Many Marines in the combat arms fields want available funds to go to field training, live fire, etc. and are reluctant to consider funding computer training.

C. MARINE CORPS POLICY

As discussed, there is currently limited use of multimedia technology in the USMC. However, under the Information Resources Management (IRM) Standards and Guidelines Program there has been applicable guidance published and there is currently a Marine Corps Order (MCO) in draft form to comply with DoDI 1322.20.

1. IRM-5231-22

IRM-5231-22 (1992), *Computer-Based Training (CBT) Development Standards*, is applicable to all contractors and USMC personnel responsible for the creation of CBT. This IRM provides general guidance on the procedures and standards to be employed when developing courseware. In particular, Chapter V covers authoring standards and provides guidelines on incorporating text, audio, graphics, and animation in courseware. Emphasis is made that MIL-STD-1379D will be followed by all contractors or in-house developers of courseware for the Marine Corps.

2. Marine Corps Order 1553._

MCO 1553._ is currently in draft form and it is anticipated to be signed in 1993. The purpose of the order is to establish procedures for the development, management, and acquisition of ICW in compliance with DoD standards and policies previously discussed. In particular, it implements DoDI 1322.20. The intent is to ensure that only educationally sound and cost-effective ICW is developed. In that regard, all proposed ICW projects

must support a training deficiency or requirement and be submitted to the Commanding General, MCCDC for validation and approval. Local commands will be responsible for funding or the submission of a POM initiative if funds are unavailable.

The emergence of a draft order is a significant development because it signals an endorsement by the Marine Corps of multimedia technology. The following benefits can be expected:

- Top level leaders at commands throughout the Marine Corps will be made aware of multimedia technology as a training option.
- A MCO legitimizes and encourages the use of ICW.
- Any local initiatives that are already under development will be reported and made available for use throughout the Marine Corps.
- Marine leaders will be made aware of the DITIS database as a source of ICW.

D. POTENTIAL

Although multimedia has not yet significantly impacted in USMC training applications, the potential to do so is there.

1. Training Requirements

Training within the Marine Corps is a vast undertaking involving considerable expenditures of personnel and money. *The Military Manpower Training Report (MMTR) for FY 1993* (1992) provides some idea of the scope involved. Training Load is defined as the average number of students and trainees participating in formal institutional training and education courses during the fiscal year. The projected USMC training load for FY 1993 is 19,016 personnel for the regular Marine Corps and 3,418 for the Reserves. Individual training requires manpower to conduct and support instruction, manage military schools and training centers, maintain training bases, and provide support to students, staff members and their dependents. Projected manpower in support of individual training for the Marine Corps in FY 1993 is 11,000 military personnel and 1,000 civilians. Funding required for training includes pay and allowances for the students and trainees undergoing training, pay and allowances of military and civilian personnel in support of training, operations and maintenance costs, and training related procurement and construction. The projected USMC total for FY 1993 is $1,349,000,000.

The MMTR provides information only on training provided to military personnel in formal courses conducted by organizations whose primary mission is training. It excludes all training conducted by operational units incidental to their primary mission. For example, unit training, on the job training, and field exercises are excluded. The amount of resources allocated to this type of training is difficult to determine, but it would certainly substantially increase the numbers of personnel and monetary amounts provided in the previous paragraph. (Flecther, 1990)

2. Environment

The Marine Corps is currently operating in an environment where manpower reductions, budget cuts, and base closures will force it to find innovative ways to ensure that training proficiency is maintained. At the same time, training is more complex and difficult to accomplish. Alternative solutions will have to be considered. IRM 5231-22 provides the following guidance:

> During a time of reductions in training staff and increasing budget constraints, the use of CBT technology has proven to be cost-effective over the long term. Using CBT instruction allows individuals to progress at their own pace, helps to minimize the impact of personnel turnover by providing instruction in local procedures or the use of specific pieces of equipment, provides consistency in presenting information and minimizes the long-term cost of providing the training. (IRM-5231-22, 1992)

VI. FOCUS GROUP RESEARCH

A. OVERVIEW

A focus group is a planned and moderated group discussion designed to obtain information on a specific area of interest in an environment where disclosures are encouraged. Groups are small and are composed of people who have some homogeneous characteristic that allows meaningful data collection for a particular topic. The data gathered is of a qualitative nature and can offer rich insights into the subject matter being researched. As ideas and perceptions are shared, synergism often develops that provides results not obtainable from other research methods.

The source for the material in this chapter is Shamdansi's and Stewart's (1990), *Focus Groups: Theory and Practice.* This book is one of the most recently published references and views the topic as an applied science research method rather than a marketing research tool. It serves as a guide for the conduct and application of focus groups as well as providing a theoretical context for their use.

The use of focus groups can be traced to work done in 1941 by Paul Lazarsfeld and Robert Merton at Columbia University where audience reaction to recorded radio programs was studied. After World War II, Merton applied this technique to an analysis of Army training and morale films for the Research Branch of the United States Army Information and Education Division headed by Samuel Stouffer. Merton along with others published papers and books on the technique used. The method became disseminated and began to have widespread use.

Since that time, focus groups have taken on many different forms and do not follow all the procedures as they were earlier defined. For example, they have been extensively used in market research to enable manufacturers to understand the thinking process of consumers. Today they are again becoming increasingly popular as an important tool for researchers in the social sciences.

Focus groups are just one type of group research. Other types include nominal group technique, Delphi technique, brainstorming, and synectics. The term focus implies that the topics covered will be limited to a narrow range. Much is known about the interaction of small groups and the analysis of qualitative data. It is on this knowledge that the validity of the focus group interview as a scientific tool rests.

Focus groups are primarily concerned with the collection of qualitative data. This forum provides a rich body of data as expressed by the group members. Individuals are allowed to respond in their own words using phrases and associations they choose. They are only minimally imposed on by the researcher and research setting.

B. USE AS A RESEARCH TOOL

It is important to use focus groups in a manner that is consistent with the objectives and purposes of the research. They may be used at any point in a research program, but they are particularly useful for exploratory research where little is known about the subject or as a method to confirm results obtained by other research methods. The following are common uses:

- Obtaining general background information about a topic
- Generating hypotheses for further research
- Stimulating new ideas
- Diagnosing potential problems with a particular area
- Generating impressions of the topic being researched
- Learning how respondents talk about the phenomena of interest
- Triangulate previous results

C. ADVANTAGES AND LIMITATIONS

Focus groups are one of several research methods that can be used to gather data. When choosing this method, it is best to compare the advantages and limitations to ensure the proper collection technique is being used. The following are advantages:

- Focus groups provide data from a group of people quicker and cheaper than other forms of participant research.
- Focus groups allow the researcher to interact with the group and pursue follow up questions and interpret nuances such as tone of voice that may add meaning to the response.
- The open response format provides data in the respondents own words.

- Focus groups produce synergy that provides a richer type of data than other methods.
- The results of focus groups are easy to understand. This is in direct contrast to studies that rely on complex statistical analysis.

Many of the limitations are simply the negative effects of the advantages previously discussed and include:

- The small numbers of participants can limit generalization to a larger population.
- The interaction of the respondents to the researcher and one another can be influenced by intentional or unintentional moderator bias and the group discussion could reflect the opinion of a dominate or influential group member.
- Sometimes more credibility may be given to focus group results than those of a statistical survey because of the actual "live" interaction with the respondents. This may not always be justified.
- The open ended nature of discussions can often make summarization and interpretation of results difficult.

As with all forms of research, the advantages and limitations have to be taken together to determine if a research objective can be obtained. Focus groups are best used in conjunction with other methods. However, there are situations when they can be used as the sole basis for decision making. One example would be when a group is relatively homogeneous at least concerning the issue at hand.

Focus groups are just one method available to a researcher. They represent an important tool for discovery and exploration. When used appropriately, they can provide data that could not be obtained by other means and often represent the most viable option.

The biggest criticism of focus groups is that they obtain qualitative data from a relatively small group of participants. However, that is precisely their function. When used properly or in conjunction with other methods, the results obtained are valid. They can become a problem when used to answer research questions for which focus groups are inappropriate and questions that are better served by other methods.

VII. RESULTS OF FOCUS GROUP RESEARCH

A. PURPOSE AND OBJECTIVES

In conducting research for this thesis, the focus group was one of several methods employed to obtain data. As previously discussed, multimedia computing is not widely known or used in today's Marine Corps. The use of focus groups was deemed appropriate both as a confirmation and exploration tool in analyzing the implementation of multimedia for training applications in the USMC. The target audience was Marine Corps officers attending the Naval Postgraduate School (NPS). They were chosen because of ease in recruitment and because they are representative of leaders who may implement or use this technology. The specific objectives were:

- To validate, amplify, and determine applicability of information received from other sources such as telephonic interviews and literature reviews.
- To generate ideas and discussion that would be of relevance in implementing multimedia computing systems for training applications.
- To hear the opinions and ideas of Marine officers who may be faced with implementing this technology and/or using it in the future.

B. SCOPE OF GROUPS

1. Group Composition[17]

All participants were Marine officers and students at the Naval Postgraduate School in Monterey, California. This provided homogeneity that is important so that some form of consensus on issues can be obtained (Krueger, 1988). However, some diversity is also necessary to ensure that there will be a lively and interactive discussion (Krueger, 1988). This was obtained by having participants with different ranks and Military Occupational Specialties, various lengths of time in service, and from different curricula and graduating classes within curricula.

The emphasis was to select personnel who were studying in the areas of Computer Science and Information Technology Management because of their exposure to

[17]Demographics of group participants are contained in Appendix B.

computer technology. Marine officers from other curriculums were also chosen to provide balance and a viewpoint that would be less technologically oriented. All participants were considered leaders who would be involved in any future Marine Corps implementation of multimedia. Forty-one individuals were initially contacted via a recruitment letter sent through the student mail service. Attendance was confirmed by individually calling each participant. Thirty-four individuals were successfully contacted and 33 agreed to participate.

2. Group Size and Number

The recommended number of participants for a focus group range from four to 12 people (Morgan, 1988). Fewer than four could loose the effects of group synergy and interaction and more than 12 would be unmanageable and not allow adequate individual participation (Morgan, 1988). This study used seven participants per group. To ensure adequate attendance in case of a no show, eight members per group were scheduled. All groups conducted had perfect attendance, so one participant was asked to leave before the start of each session.

It is recommended that three to four groups be conducted to provide a means to triangulate what other groups have said and to provide for different viewpoints that may not come out if a smaller number of groups are held (Morgan, 1988). Groups are to be held until data obtained becomes repetitive and the moderator can begin to anticipate what the members' responses will be (Morgan, 1988). For this study, four groups were scheduled. The first two groups produced a variety of responses. The third group provided no new substantive material, but was important in confirming the results of the first two groups. Upon conclusion of the third group, it was determined that a fourth group would be unnecessary.

3. Location

The site chosen for the group sessions was a classroom located on the NPS campus. It was a convenient meeting place for all participants and was designed to

conduct group interviews. As such, it included a video recording system and a one-way mirror for observation by others interested in the study.

4. Procedures

Each session was conducted with the author of this thesis as moderator. The sessions lasted approximately 90 minutes and were videotaped. Questions used were developed after the majority of telephonic interviews and the literature review were completed and were based on information obtained from those two research methods. Each group was asked the same core list of questions[18]. Each session started with a demonstration of several multimedia applications on a computer in the interview room. The purpose was to provide a basic familiarity of the technology and illustrate its capabilities. This was followed by an explanation of the purpose of a focus group, guidelines for conduct, individual introductions, and then the research questions. At the conclusion of each session, immediate impressions were noted by the moderator. Following all three sessions, tapes were analyzed and evaluated to detect common themes.

C. RESULTS

The results of the focus groups (focus group interviews, 12 January 1993, 14 January 1993, and 19 January 1993) are presented in the remainder of this chapter. This will include both descriptive and interpretive analyses.

1. Previous Exposure and Knowledge of Applications within USMC

In general, previous exposure to multimedia was limited. This included demonstration of the technology in classes at NPS, seeing it at local retail computer outlets, advertisements on television, or articles in computer periodicals. Several

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[18] Refer to Appendix C for the discussion guide. The discussion guide provided only the framework for questions. Questioning techniques were adapted to fit the personality of each group involved. This included the use of open and closed probes, serendipitous questions, and follow-up questions to provide clarification. Answers to questions often overlapped several categories. This included spontaneous discussion of an issue before it was raised or rehashing of topics that were previously discussed in light of the current question. This type of interaction and synergism is one of the primary ways focus groups provide rich qualitative data.

participants had multimedia capabilities on their personal computers and several more were considering upgrading their systems to include this capability. One individual had utilized a multimedia training application as part of his studies at the Defense Language Institute. Several members had no previous exposure to multimedia computing except for the demonstration held at the beginning of the session. All members indicated that the demonstration, coupled with previous computing experiences, provided enough of a background to participate in the discussion.

When queried concerning multimedia applications within the Marine Corps, most participants indicated they knew of no applications. Several people provided examples of computer-based training that was not really in the context of multimedia as defined for this thesis. These included flight simulators, embedded computer programs, part-task training devices, and text-based computer-aided instruction. There were no truly multimedia capable training applications mentioned.

2. Current Implementation of Multimedia within the USMC

The participants were informed that during research for this thesis there was very little evidence found of multimedia training applications within the Marine Corps. They were also informed that other armed services have implemented this technology in many training areas. They were asked to provide reasons why the Marine Corps has lagged behind and what they thought were the perceived objections for implementing this technology[19]. As the discussion progressed, perceived objections obtained during the telephone interview process were introduced for comment[20]. Participants were probed concerning the validity of objections and ways to overcome them. The intent of this phase of the focus group was to stimulate discussion on the current level of implementation of multimedia for training within the USMC. The following is a summary of those discussions.

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[19] The objections raised were not necessarily personal objections of the participants but reasons they perceived for lack of USMC multimedia development.

[20] Many of the objections raised during the focus group were the same as those obtained through the phone interviews.

a. Resource Constraints

The most frequent and immediate response for the lack of multimedia applications was the limited amount of money available in the Marine Corps for development. In contrast, other services were viewed as having not only sufficient funds but excess amounts to devote to areas such as multimedia courseware. Representative comments included:

We are so much smaller in comparison to other services and they can devote resources that we don't have.

Our size and budget are so small we don't have the luxury to delve into areas like this.

Money is a factor and has been a factor because it is a factor in everything else we do in the Marine Corps.

Money is the bottom line. We don't have what we rate in the squadrons for even basic computer capability.

Besides money, the limited number of Marines and civilian employees in the data processing and training/educational communities contributed to the lack of in-house development. These individuals were described as already overburdened with many tasks and could not be expected to take on more. The Marine Corps' unwillingness to increase people or re-order priorities contributed to this problem. Again, the Marine Corps was considered to be at a disadvantage when compared to the other services.

The lack of hardware to run applications and the expense of replacing obsolete computer equipment were considered important reasons why the technology was not implemented. This was based on previous personal experience.

Long justifications required to purchase computer equipment and then told we don't have the money for that.

We would rather put money into things that are operational than computers.

Several people felt that computer technology often had hidden costs that contributed to a wariness to embrace it for training applications. This included obsolescence of hardware that needed constant upgrading and poorly designed software that cost more to maintain than it did to develop.

It was felt that the issue of resource constraint could be overcome if the benefits of multimedia were more widely known. Participants expressed the view that no one currently sees a benefit to using this technology and recommended that key decision makers be fully briefed on how it could either reduce costs or improve training and effectiveness. If advantages could be established, it was considered likely that multimedia training could be implemented in the future. Another suggestion was to update existing hardware to be multimedia-capable and include this capability in new equipment so that a platform could be used for training when not serving its primary purpose. Finally, if a broad based commitment could be obtained, this was viewed as providing economies of scale that would lower the per student cost of implementing multimedia and make it economically viable.

b. Top Level Support

While money was the most immediate response for lack of implementation, the area considered most critical was top level support.

You can't have resistance at the top level or it is not going to work.

There was a divergent discussion as to why top echelons of Marine Corps officers have not championed this as a way to train Marines. One side felt that much of the Marine Corps' senior leadership is not comfortable with computer technology or they preferred more traditional training methods. Comments included:

Some general officers have never sat in front of a computer. It is hard to get top level support for something like this.

The Marine Corps is the most traditional service. It is not a matter of technology. If that is the way I was brought up, why should I change to something else?

Officers with a computer, communications, or intelligence background don't get promoted beyond colonel.

Others felt that top level leadership was comfortable with technology but had other reasons for not endorsing multimedia training. This included limited resources, more important priorities, and lack of exposure as to its capabilities.

I don't think our generals are that out of it. I think it is a resource thing.

Probably not sold effectively to our senior officers.

Decision at top has been to use funds for more demanding and pressing requirements than buying computer systems.

It appeared that an individual's previous experience with senior officers and how they had supported computer technology was a key factor in how this issue was viewed. Examples were provided of how information systems and computers were both thwarted and nurtured by general officers. This issue was discussed and there was general agreement that it was personality-dependent. As with the resource constraints, it was emphasized that exposure and a better understanding of the technology were important if senior leaders were going to support it. Without top level support, implementation was considered highly unlikely.

c. Comparison to Traditional Training Methods

The tendency for Marines to favor traditional training methods was a factor that restricted how they perceived training should be accomplished. This was considered more prevalent in the thinking of top leaders. Several people felt there was a tendency, especially in the combat arms, to embrace certain types of training.

If it doesn't shoot move or communicate (implying tactical voice radio) we don't want it.

Some leaders are just gunfighters.

The consensus was that Marines wanted to spend as much time as possible doing training at a level and fashion that could not be satisfactorily represented by multimedia applications. This included combat skills development, field exercises, and live fire. There was also a concern about the impersonal nature of computer training.

Some training just needs the human touch.

In the war fighting business, some things will be lost without instructors.

Although there was unanimous agreement that traditional training such as field exercises should remain the number one priority, many participants felt the current environment of downsizing and budget cuts would provide a better atmosphere for alternatives to be considered.

Can't get any good training on Okinawa. We need other ways to train.

Tendency to train, train, train, (in the field) but we will have to get real and meet it half way with other options.

Need to retool our training methods to consider the multimedia concept.

An analogy was drawn between multimedia applications and flight simulators. Although pilots want real stick time, the simulator has proven an effective and money saving way of maintaining and gaining proficiency when actual flight time was not available.

Because there is a tendency to embrace traditional training, future acceptance of multimedia applications was considered viable only in an adjunct role.

Don't take out the human factor, use multimedia for augmentation only.

Don't use it to replace training. It is valuable to reinforce training and valuable to prepare people for training. I can see a lot of good things if it is used properly.

d. Use of Courseware Developed by Other Services

During discussion, participants asked why the Marine Corps had not adopted courseware from other Services. In answer, they received a question in return. They were asked if it was because of reluctance to use training material that was not developed by or directly for the Marine Corps[21]. This was quickly refuted as invalid. Numerous examples were provided of the Marine Corps' long standing use of various service schools. This included artillery training at Fort Sill and armor training at Fort Knox. Comments included:

We already use other service schools with no problem.

Jointness is being mandated. Interoperability is here and it is going to happen.

Interoperability and jointness are becoming engrained in the DoD culture.

When probed further on the issue, participants mentioned that most Marines were probably unaware that other services even had multimedia courseware. The lack of Marine Corps computer hardware to run applications was also brought up. Many expressed the feeling that other services experience would be actively sought if multimedia is implemented in the Marine Corps and use of previously developed courseware would be embraced because of the Marine Corps penchant to save money both short term and long term.

3. Future Implementation of Multimedia within the USMC

The intent of this phase of the focus group was to generate discussion concerning the future implementation of multimedia training applications within the Marine Corps. When directly queried on this issue, all participants indicated that it should be implemented to support training applications.

We are in a changing Marine Corps and need to stay attuned to anything that will help us in the expected reductions in men and money.

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[21] This was an objection uncovered during the telephone interview process.

I don't think we can avoid it. I think the technology is driving us. The advantages it offers us is going to make it a necessity.

The kids out there are smart. If you introduce something like this, they will be all over it.

Although everyone agreed it should be implemented, there were many reservations and concerns.

Need strategic vision. Some things are good for this and some are not.

We need to have a good plan and support from top to bottom.

Could have adverse effects if not closely monitored.

This type of training will happen. We have to decide which way it will go.

In the following sections, a closer look is provided on the range of discussion on this issue.

a. Concerns

The fear that supporting the technology could become a driving factor over training Marines was a prevalent issue. Many participants had experience with computer systems that were touted as saving time, money, and paperwork and ended up doing just the opposite. Others had used technology so full of bugs that it became a bigger chore to maintain the system than any advantage it provided.

Have to prove that it is not going to be more time consuming and it will actually be beneficial to use and accomplish the training mission without sacrificing other things.

There were also stories of having computer technology dumped on a command without proper training in its use or applications and it ended up either unused or used improperly.

My biggest gripe is a new box or new set of software showing up and nobody to show me how to use it. If there is no long term commitment to maintain this, sooner or later you will get overcome with other priorities.

Some were concerned that multimedia applications would be implemented inappropriately and leaders would be required to use them despite their objections. It was important that a commander's initiative not be taken away. Again, it was stressed that it be used in an augmenting role and as part of a total training package that involved human instructors and traditional methods.

Participants wanted to be able to take any multimedia applications with them to the field or if they deployed. They did not view this as something that should only be available in a garrison environment.

Reluctance to embrace this technology totally because computers will get dirty and not function in the field or there will be no power.

Is this thing deployable, can you take it to the field?

This set off a whole train of discussion on how other computer systems either did or did not function in adverse environments. The outcome was that multimedia applications and hardware purchases should be able to be part of the Marine Corps' expeditionary nature.

b. Recommended Implementation Strategies

It was considered vital that a Marine Corps Order be issued to initiate standards and policy guidelines for the implementation and use of multimedia. Many people had experiences where software packages such as word processors and spreadsheets were different in every command in the Marine Corps and they did not want to see the same thing happen with multimedia.

We have to come down with standardization.

If you don't have it directed from Headquarters Marine Corps, the east coast will have one thing, the west coast another, and Okinawa something else.

This technology is a very useful tool if we look at the capabilities and limitations. Before they start fielding this, and something they have never done in my 15 years, is develop a decent plan to implement it.

At the same time, it was considered important that local commands be given initiative in working with and developing applications. Several instances were cited of software programs that had been produced by local Information Systems Management Offices and then adopted Marine Corps wide.

There are a lot of good ideas that will bubble up.

People will come forward who will find ingenious ways to do things of which higher headquarters would not even think .

In order for the technology to be accepted, first-rate applications that do not detract from the training experience will have to be fielded. It was felt that if a poor quality program came out early in the implementation process, this would bias Marines against it and hinder future applications.

Need to design it so you make money right off the bat.

It was also recommended that early implementation be confined to a formal school or limited functional area to increase the likelihood that a quality program would be deployed.

Schools should be getting on board first then go to the Fleet.

The ability to quantify success, show how it relates to combat effectiveness, and provide positive feedback to the users were considered crucial.

Need to be able to quantify its success. What were the initial goals and did we achieve them?

If you want to really sell this to the Marine Corps, it must have a direct link to shoot, move, and communicate.

If a direct link can be made to combat effectiveness, as soon as that link is made, the generals are going to jump on this.

Exposure of the capabilities of multimedia Marine Corps wide was considered important so that leaders would become aware that this type of technology was available. This did not have to be limited to a training application. Any type of quality and appealing demonstration, like the CD-ROM disc *"A Line in the Sand,"* was considered an appropriate venue to get people thinking and asking questions.

c. Potential Applications

The most frequently mentioned and enthusiastically embraced recommendation was to transition Marine Corps Institute correspondence courses into multimedia applications. This was seen as making an impact Marine Corps wide and a very appropriate application for multimedia.

Follow-on formal schools were considered a good place to implement multimedia applications. The general feeling was that this could be applicable in almost all schools. Examples included the Communications-Electronics School, Supply School, Disbursing School, Personnel Administration School, and Computer Science School.

This would not only provide the student a better training program but had other benefits as well.

> *Reduce number of instructors. Can get technical experts in the schools back out to the fleet where we can use them.*

Professional development education was another area to implement selective applications. This would be appropriate in classes where course content had to be exact and standardization was important. Schools mentioned were Noncommissioned Officers Schools, Staff Noncommissioned Officers Schools, and Amphibious Warfare School (AWS).

> *Take it from a graduate of AWS, some of those things taught there could have been done better with multimedia.*

There were several innovative ideas discussed to take advantage of multimedia's capabilities.

Because of operational tempo, many times all training requirements are not met. This type of technology can be turned on like a switch. Don't need a qualified instructor, people can just walk in the door and start to train. Won't be taking others away from some other task just to instruct a class.

Use a mobile trailer replete with these things and take it where it is needed and use it to knock out individual skill or individual skill refresher training.

Another suggestion was to augment the Mobile Training Teams sent out by the two Landing Force Training Commands. It was envisioned that multimedia applications could be completed in preparation before a team arrived and then as follow-up and reinforcement after they left.

Use as an indoctrination device for Marines going to foreign countries was considered an ideal application. This type program could include audio samples of common spoken phrases and video of likely areas of operation.

It was also recommended for areas where an exact method or procedure had to be conveyed and you did not want to have the content improperly presented by an instructor.

Can get out what you want without any intermediaries.

It helps to have a real instructor, but the class being taught will only be good if the instructor is good.

It was seen as good for situations were conventional training methods were restricted or difficult to employ. This included Marines who were deployed on ships, Marine Security Guard detachments, and subjects for which there were limited qualified instructors such as Nuclear, Biological, and Chemical Warfare. Finally, it was recommended as a way to augment live fire by reviewing techniques with a multimedia program before going to the range.

D. SUMMARY[22]

Focus group participants felt that multimedia training applications should be implemented within the Marine Corps. The critical factor is the necessity to develop top level support and interest. It is vital that exposure and education, concerning the capabilities and limitations of this technology, take place before senior officers endorse it and others embrace it. A definite benefit must be seen. This could include cost savings or improved efficiency. To be truly successful, a link has to be established to combat effectiveness.

Multimedia should primarily be used as a means to augment conventional training. It will be most beneficial when combined with conventional training. Technology should never be allowed to become more important than the needs of the individual Marine or take away a commander's initiative. Standards and clear policy must be provided by higher headquarters so that development is consistent throughout the Marine Corps. However, individual commands should be allowed latitude and creativity. Adequate hardware must be available before applications are fielded. The technology must be deployable and fully capable of operating in a field environment. Applications must be implemented in accordance with an overall plan in mind. It is important that Marines receive instruction in the proper ways to use the technology and that support be available so that the technology can continue to be used correctly.

Multimedia is just one aspect of the information technology revolution. The Marine Corps should examine the lessons learned by other services, utilize DoD courseware that has already been developed, and plan to implement properly designed applications of their own.

The focus groups substantiated previously obtained data that there are limited multimedia training applications in the USMC and little knowledge of the technology. The results confirmed the majority of objections obtained from the telephone interview

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[22] This is an interpretive summary based on the moderators participation in all three focus groups.

process. The only objection refuted was the reluctance to use interactive courseware developed by other services.

The potential training applications discussed generally fall in the categories recommended by Wright (1993). The recommendation to use multimedia to augment rather than as a stand-alone package agrees with Fletcher's (1990) finding that results are better when this approach is used. The need seen for standards and guidance from higher headquarters agree with current DoD policy.

The issues raised by the focus groups provided data that could not be easily obtained by other means. The concerns, strategies for implementation, and potential applications should be reviewed and considered in USMC multimedia training implementation plans.

VIII. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

1. Focus Groups Provided Unique Data

The focus groups conducted for this thesis provided information that could not have been obtained by other research methods. The qualitative data obtained was rich and knowledgeable and provided insights that could not have been obtained using survey questionnaires. Participants were free to express ideas in their own words and were not confined to a set response found on surveys. They were able to provide clarification and react to responses made by others in the group. Information such as the evident contradiction in sentiment about implementing multimedia (top down versus bottom) is an example of an important finding that would not have been revealed in questionnaires which are models of consistency in responses. The interaction and synergism that occurred in the focus group sessions provided a body of meaningful data that will be useful when considering implementation of multimedia training within the USMC.

2. Fletcher's Study Supports Use

Fletcher (1990), under the auspices of the 1989 Department of Defense Appropriations Bill, conducted a study pertaining to the use of IVD technology. The study found that in many situations IVD is both more effective and less costly than conventional instruction. The conclusion was that IVD should be routinely considered and used in military training. The study went on to indicate that the results would be valid for technology, such as digital audio, digital video, and CD-ROM applications, that had the same functionality as IVD.

3. DoD Policy Supports Use

DoD is one of the biggest users of ICW in the world (Payne, 1991). As a result, there have been measures taken to formalize its use. MIL-STD-1379D establishes procedures to follow when developing training requirements and writing contracts for

courseware. MIL-HDBK-284 provides amplifying guidance and covers analysis, design, acquisition, management, and portability issues. DoDI 1322.20 issues policy with the objective of increasing the cost-effective use of ICW for military training. DAGIC and JASG serve as forums for all Services to discuss issues relevant to ICW and promote its use. The DITIS database serves as a clearinghouse for ICW reuse. All these efforts support and encourage the use of ICW within DoD.

4. Portability Requirement Supports Use

MIL-STD-1379D defines the portability standard for ICW within DoD. DoDI 1322.20 establishes policy that this standard will be complied with. Together they provide guidance to ensure that ICW will be portable across the variety of hardware platforms and operating systems within DoD. The effect will be lower per-unit costs, lower development costs, and increased efficiency resulting in more widespread use of ICW within DoD (Fletcher, 1992).

5. Focus Group Results Support Use

Focus group results supported the implementation of multimedia applications within the Marine Corps. Participants indicated that multimedia should augment conventional training and not replace it. Top level support combined with formally issued policy and standards were considered critical to success. It was also important that a connection to combat effectiveness be established. Most participants thought the technology should be deployable and capable of operating in a field environment.

6. Marine Corps Policy Supports Use

There are existing and pending policy measures that provide guidance supporting the use of multimedia training within the Marine Corps. IRM-5231-22 discusses the development of training applications with multimedia capabilities and endorses the guidance contained in MIL-STD-1379D. This IRM additionally recommends that CBT be considered for use during periods of reduced manpower and restricted budgets which the Marine Corps now faces. When signed, MCO 1553._ will contain procedures and guidance that implement the policies outlined in DoDI 1322.20. This

order will provide exposure to Marine leaders and serve as a means of legitimizing and standardizing the development of multimedia training applications. The result should be increased initiatives by formal schools and local commands to utilize this training medium.

7. Awareness in USMC is Developing to Support Use

The Marine Corps has lagged behind other services in the use of ICW. This can be related to lack of resources, limited top level support, and preference for traditional training methods. The technology has not had wide exposure and knowledge of its capabilities and limitations have been confined to a very small number of educational specialists and personnel associated with information systems. This is beginning to change. There are now fledgling ad hoc efforts to develop training applications with multimedia capabilities. The recent release of the CD-ROM disc, *"A Line in the Sand,"* although not a training application, should create interest in multimedia in general. As discussed, the pending approval of MCO 1553._ will provide needed exposure and legitimize and standardize the use of multimedia for training.

8. Reality of Downsizing and Fiscal Constraints Support Use

Although specific personnel reductions, budget cuts, and base closures are still being debated by Congress and the President, it is certain that the Marine Corps will have fewer people and reduced funds to achieve their training requirements in the future. At the same time, training will be more complex and more difficult to accomplish. Alternative solutions to ensure Marines will receive adequate training to allow for mission accomplishment will need to be considered. Since multimedia applications have already proven successful throughout DoD, it is likely to be one of the alternatives the Marine Crops will consider.

B. RECOMMENDATIONS

1. Implement Multimedia Training Applications

The Marine Corps should implement multimedia training applications. The following specific recommendations are offered:

- Complete staffing of MCO 1553._ and have it signed so that policy guidance will be available for the Marine Corps.

- A POM initiative should be submitted by MCCDC so that funds will be programmed for multimedia hardware and interactive courseware development.
- Ensure that standards for multimedia courseware development are understood and practiced throughout the Marine Corps. This should include the adoption of a common authoring language for any in-house development of multimedia training applications.
- Establish close liaison with agencies within other Services that have existing multimedia training programs in place and learn from their experiences.
- MCCDC should complete a review of the DITIS database to determine if there are any existing applications that could meet current needs within the Marine Corps.
- Multimedia applications should primarily be used in conjunction with existing conventional training programs vice as a stand alone method.
- Key personnel, such as educational specialists, decision makers from formal schools, and information systems managers, should attend the numerous conferences and symposiums held around the country on multimedia training and technology.
- Formal schools should review their curriculums to determine areas in which multimedia applications could provide training benefits or cost reductions.
- Before purchasing computer hardware, consideration should be given to including multimedia capabilities. This should take into account fiber optics and other devices that would enhance distributing multimedia applications, CD-ROM drives, and audio/video cards.
- Piggyback multimedia technology purchases to serve multiple purposes, e.g., CD-ROM drives will be useful not only for multimedia but to support other initiatives such as mass storage and retrieval.
- Provide demonstrations of multimedia training applications at forums such as General Officer Symposiums, Sergeant Major Symposiums, education and training conferences, Command and Staff College, Amphibious Warfare School, etc. so leaders and decision makers will be exposed to the capabilities of the technology.
- As multimedia computing becomes more widespread in other areas in the Marine Corps such as teleconferencing, use the increased exposure to spur development and ideas for training applications.
- Multimedia courseware and hardware should be capable of being deployed and used in a field environment.

2. Follow-on Research

The following are possible areas for subsequent research:

- Economic analysis comparing conventional instruction to multimedia instruction.
- Quantitative study based on the results of the focus groups conducted for this thesis.
- Analysis of the Marine Corps' capability to support distributed multimedia computing now and in the future.
- Case study of an organization, such as a formal school, that adopts multimedia training within its curriculum.

- Additional focus group research composed of personnel from various Marine Corps formal schools.
- Assist an organization in converting a conventional training application to one that is multimedia capable.
- Look at other ways computer and communication technology can augment traditional training such as teletraining and virtual reality training.

C. IMPLEMENTING CHANGE

Kwon and Zmud (1987), refer to Figure 1, provide a six-phase model of the information technology implementation process within an organization. Successful implementation will not occur until many types of resistance are resolved. The model contains feedback loops which may be positive or negative. At the extremes, positive feedback would result in complete incorporation of the technology while negative feedback would result in total rejection.

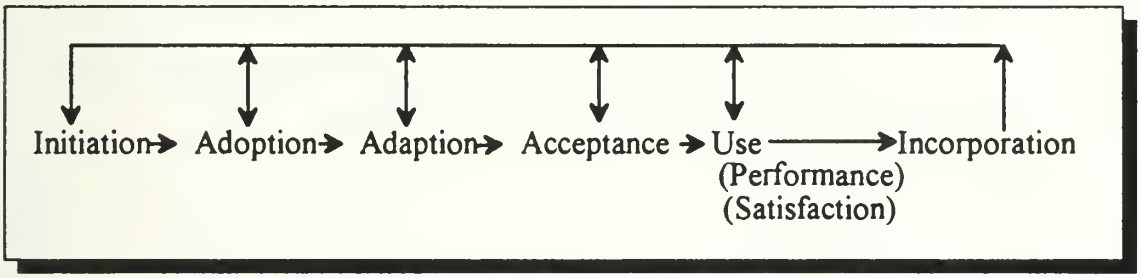

Figure 1

With respect to multimedia, the Marine Corps is currently in the initiation and adoption phases of this model. As multimedia training applications become adapted and accepted in the Marine Corps training environment, their ultimate incorporation as a legitimate training tool will depend on how users perceive performance and whether they are satisfied. It is critical that top level leaders be committed and that developers and users be knowledgeable and active participants in the process. This will require clear direction and thorough planning with achievable goals that allow success to be quantified. Implementation should be flexible enough to adjust to feedback. If these guidelines are followed, there is a much greater chance that multimedia training applications will be successfully incorporated into the Marine Corps.

Nolan (1979) also developed a six stage model to track the growth process of information management within an organization. One aspect of this model provides the progression of expenditures, refer to Figure 2, an organization will make as its information management moves from initiation to maturity (Nolan, 1979). If the implementation of multimedia is applied to this model, the Marine Corps is currently in the initiation and contagion stages. It can be anticipated that during these stages, expenditures will escalate sharply as hardware is purchased to provide multimedia instruction. Following this initial increase, fund allocation will level off as the technology is adapted in training applications. During the control stage, there will be a transition from the management of hardware acquisition to the management of multimedia applications as an information resource of the Marine Corps. As multimedia becomes more tightly integrated with training applications, there will be another increased expenditure of funds to fully incorporate it. Expenditures will again level off as multimedia matures and becomes part of the overall strategic information management objectives of the Marine Corps.

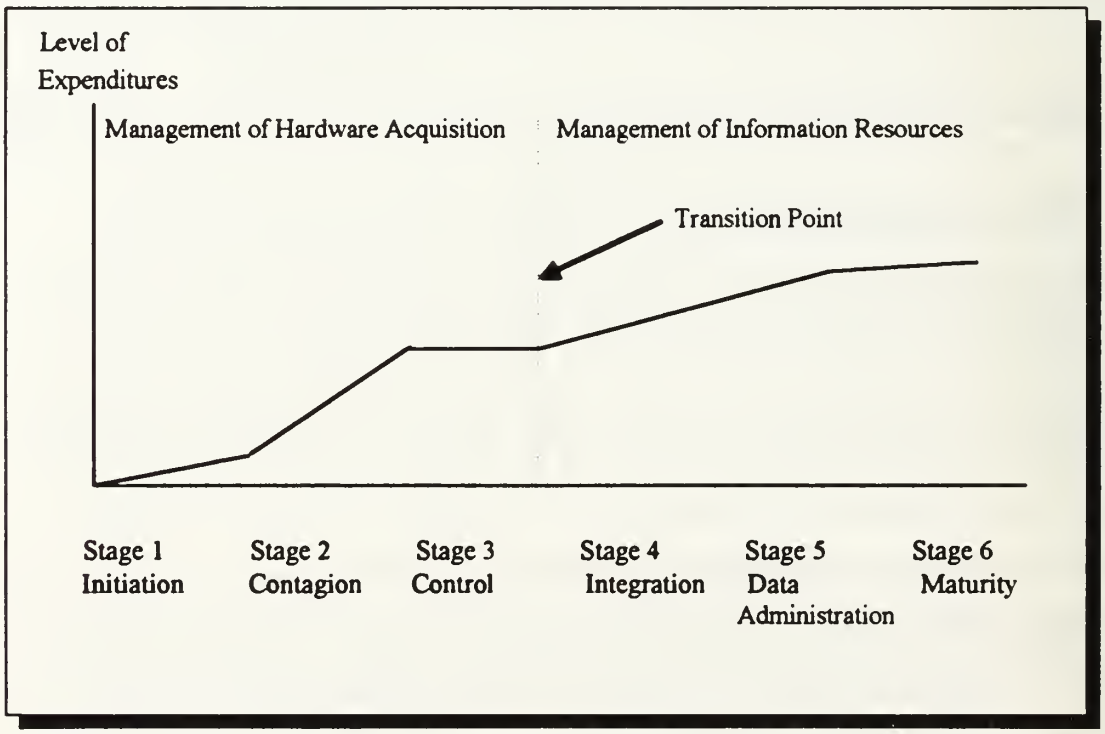

Figure 2

D. THE FUTURE

Multimedia will become more accepted and necessary in all aspects of computing. Philip Dodds, managing director of the Interactive Multimedia Association states:

> Video and audio are at the stage where graphics was about 10 years ago. I'm convinced that, during the next few years, people all over the federal government will come to appreciate the enormous benefits of multimedia. In fact, they'll grow to expect audio and video features as standards for personal computers. (Liebowitz and Zurier, 1992)

The increased use of multimedia is happening in industry, in personal computing, and throughout DoD. The time has come for the Marine Corps to take a proactive role in adopting this technology and applying it to training applications.

APPENDIX A: GLOSSARY[23]

A

ADC Analog-to-Digital Converter

Analog The representation of quantities that vary continuously. Information which steadily flows and changes. The representation of numerical values such as temperature, current, and voltage.

ATM Asynchronous Transfer Mode

Audio track The section of a videodisc or tape which contains the sound signal that accompanies the video signal. The audio track usually runs along the edge of the videotape and beside the video track on a disc.

Authoring A structured approach to developing all elements of a unit of interactive courseware with emphasis on preproduction.

Authoring language A specialized, high-level, plain-English, language-like computer program (often based on another computer language like BASIC or PASCAL) with codes specifically designed for developing interactive courseware instructional units and handling major courseware needs such as response judging. The instructional logic and instructional content are contained in one program. A set of words, notation, syntax, and semantics used by an author to specify the logic and content of instruction to be delivered by a computer. A high-level language designed to be easily learned and read by people who are concerned with instructional application.

Authoring system Prepackaged prompted authoring aides, courseware templates, or menu driven editors designed to help authors (without formal computer programming skills) create interactive courseware without elaborate programming. A high level interface and structured approach to developing and editing interactive courseware. The instructional logic and instructional content are separate.

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[23] The definitions in this glossary are from MIL-HDBK-284 (1992). This information provides amplifying guidance related to this thesis.

AVI Audio-Video Interleaved

AWS Amphibious Warfare School

B

B-ISDN Broadband Integrated Services Digital Networks

Bandwidth A term used to denote any one of the following: (a) The range of signal frequencies that a piece of audio or video equipment can record or reproduce, or (b) The range of frequencies available for signals.

C

C4I2 Command, Control, Communications, Computers, Intelligence & Interoperability

Cache Temporary, volatile storage for data requiring quick access.

CALS Computer-aided Acquisition and Logistics Support

Capt Captain

CCITT Consultative Committee for Telephony and Telegraphy

Central processing unit (CPU) The central processor or brain of a computer system in charge of fetching, decoding, and executing instructions. The computer unit or chip, where all calculations, instructions, and data manipulations are performed. The portion of a computer that directs the sequence of operations and initiates the proper commands for execution. It contains the main storage, arithmetic unit, and special register group.

Combat readiness A unit's ability to perform in combat. Combat readiness considers the status of personnel, logistics, morale, and training.

Compact disc (CD) A term used to denote a 4.75-inch, laser read, optical memory, high density storage disc medium with a constant linear velocity format for read-only (nonwritable) digital data. A medium for high density storage of digital data, currently used for storing computer data and audiovisual information (audio, video, and

electronic signals). A 4.75-inch optical disc with information recorded in a pattern of microscopic pits on the disc's reflective surface sandwiched between layers of plastic. A low power laser in a player shines on the surface, and an optical sensor reads the pits by noting changes in the beam's reflection.

Compact disc, digital audio (CD-DA) A CD-ROM disc that contains up to one hour of audio (usually music) information digitally encoded in the CLV format. A consumer oriented, high density storage of digital audio information. Also, see definition for "CD".

Compact disc, digital video interactive (CD-DVI) A standard developed by GE/RCA. A CD used to produce full-screen, full-motion interactive video, audio, and still graphics or text. A CD which utilizes DVI technology. A CD-DVI can store more than one hour of video playing time, and it can recreate and display 30 video frames per second. Also, see definition for "DVI".

Compact disc, interactive (CD-I) A SONY-Philips developed consumer oriented CD based video and audio system combining hardware and software. A home consumer version of CD-ROM, with music, pictures, and partial-screen motion video that plugs into a TV set and stereo. CD-I gives a variety of high quality digital pictures, including still photographs, graphics, and animation; and it delivers four grades of sound from AM quality for narration to CD digital audio style high-fidelity for music. However, moving video is currently only possible on 40 percent of the screen. CD-I is designed to deliver interactive entertainment (anything from encyclopedias to games). CD-I offers ease of use by having a microprocessor built into the CD-I player, which hooks up to a TV set and stereo system, and plays audio and video CDs as well as CD-I specific applications (no microcomputer is required). The user interacts with the program using a pointing device such as a joystick or mouse. Also, see definition for "CD".

Compact disc, read only memory (CD-ROM) A CD which can store more than one-half gigabyte (greater than 500 MB) of read-only (nonwritable) data and has a constant linear velocity format. A medium for digitally storing and delivering large volumes of information. Also, see definition for "CD".

Compact disc, read only memory, extended architecture (CD-ROM XA) A CD that is a hybrid of CD-ROM and CD-I proposed by Philips, Sony, and Microsoft. This technology requires a microcomputer and gives CD-ROM users the ability to access some of CD-I's audio and video features, and CD-I users the ability to play some (but not all) CD-ROM XA discs. Also, see definition for "CD".

Compact Disc, Read Only Memory (CD-ROM) player A device that reads and retrieves data from a "CD-ROM".

Computer assisted instruction (CAI) The use of computers to aid in the delivery of instruction.

Computer-based instruction (CBI) All use of computers to aid in the delivery or management of instruction. Also, called "computer-based education" and "computer-based learning".

Computer-based training (CBT) Instruction delivered by a computer which includes CAI, CMI, as well as computer simulation and part-task training. Use of computer systems in a primary or direct support role in the development, delivery, and management of instruction. An instructional methodology where students interact individually to instruction presented through a variety of media controlled and monitored by a computer.

Computer-based training system (CBTS) A training system which consists of computers that provide instruction. An automated, integrated instructional system which includes the design and development of instructional materials (authoring system), the management and administration of training, and the delivery of that instruction.

Computer-managed instruction (CMI) The use of computers to manage instructional processes, generally including registration, pre-testing, diagnostic counseling, prescription of learning experiences, progress testing, post-testing, determination of student mastery of objectives and disenrollment.

Constant angular velocity (CAV) A mode of videodisc playback where a disc rotates at a constant speed, regardless of the position of the reading head or stylus, making each frame separately addressable. A videodisc with information configured in concentric circles in order to provide rapid and discrete access. Indiviudal frames can be identified and retrieved quickly and easily. There is rapid, random access which is a basic requirement for an interactive videodisc (IVD). A CAV videodisc revolves at a continuous speed of 1,800 rotations per minute, contains 54,000 frames per side, and assigns a variable track length to each frame. One revolution generates one video frame. Compare with definition for "CLV".

Constant linear velocity (CLV) An extended-play videodisc with information configured in a spiral, similar to a record, to provide continuous, linear play. A consistent length for each frame is maintained, thus enabling longer playing time per side. CLV videodiscs assign a fixed track length to each frame and spin at a speed

which gradually decreases as the disc plays. CLV discs allow twice as much playing time per side than CAV discs, but many user control capabilities of the CAV format are forfeited. The CLV disc can be read in linear play only, but can provide chapter search capability. A CAV videodisc contains 108,000 frames per side but restricts access in terms of chronological time. They are usually used for entertainment such as movies. Compare with definition for "CAV".

Cost/benefit tradeoff analysis An analytic approach to solving problems of choice. It requires the definition of objectives, identification of alternative ways of achieving each objective and the identification, for each objective, of that alternative that yields the greatest benefit for a given cost or produces the required level of benefits at the lowest cost. When the benefits or outputs of the alternatives cannot be quantified in terms of dollars, this process is referred to as cost-effectiveness analysis.

Cost-effectiveness analysis (CEA) A comparative evaluation of potential instruction methods and media to determine the most efficient alternative.

Courseware Paper-based, audiovisual, and electronically stored instructional material necessary to deliver a lesson, instructional module, or course. For CBT, courseware also includes the special applications programs and other software necessary to present instruction.

Curriculum A set of courses constituting an area of specialization. All training conducted within a school, outlined into specific topics, along with detailed training objectives, to include behavior, conditions, and standards.

D

DAC Digital-to-Analog Converter

DAGIC Department of Defense Group on Interactive Courseware

Defense Instructional Technology Information System (DITIS) A standard, DoD-wide database designed to facilitate ICW resource sharing within the DoD Components by providing a central source of ICW information. The DITIS database provides information on all DoD-owned ICW programs, whether fielded or under development, including information on delivery system, operating software, authoring tools and courseware for both planned and fielded ICW systems.

Digital Numerical representation of information. Data which is generated or translated into a pattern of discrete, fixed values such as digits or other concrete characters. Information stored as a series of "1"s and "0"s.

Digital data Information transmitted in a coded form represented by discrete signals.

Digital video interactive (DVI) A technology developed by GE/RCA. A standard for storing a large amount of digital data and producing full-screen, full-motion interactive video, audio, and still graphics or text. The interactive portion of DVI allows the viewer to manipulate, modify, twist, or otherwise control every aspect of the picture and sound. DVI works by using heavy-duty data compression to store a large amount of digital data and unpacking the data when it is needed. DVI products can be stored on any medium that records digital signals, including CD-ROM discs. The technology requires a personal computer, typically an AT-command compatible machine, and uses a two chip custom video display processor (VDP) that lets users process and display images either on a computer monitor or on a television set. A DVI compact disc can store more than one hour of video playing time, and can recreate and display 30 video frames per second. Also, see definition for "CD-DVI".

DITIS Defense Instructional Technology Information System

DoD Department of Defense

DoDI Department of Defense Instruction

DOS Disk Operating System

E

ELMS Electronic Mail System

Embedded training Training involving simulation or stimulation of operational equipment performance in addition to the equipment's primary operational function(s). Training provided by capabilities not specifically required for mission completion, but that are built into or added onto operational systems, subsystems or equipment to enhance or maintain user's skill proficiency.

Environment The physical conditions and surroundings in which a job is performed, or in which learning takes place, including tools, equipment, and job aids.

F

FDDI Fiber Distributed Data Interface

FFOL FDDI Follow-on

Follow-on training Training conducted after initial training.

Formal training Training (including special training) in an officially designated course conducted or administered in accordance with appropriate course outline and training objectives.

Frame (film) A single, complete projected image from photographic film, running at 1/24 second.

Frame rate The speed at which frames are scanned: 30 frames per second for NTSC and 24 frames per second for film.

Frame (video) A single, complete video picture composed of two interlaced fields totaling 525 lines (NTSC), running at 1/30 second. A single frame is a CAV videodisc reference point.

Freeze frame A single stopped frame from a motion sequence. A single frame from a motion sequence displayed as a still image. Unlike a still frame, a freeze frame is not a picture originally shot to appear on its own, but is one frame taken from a longer moving sequence.

Full-motion video Video which is displayed such that on-screen motion appears to be smooth and continuous.

G

Graphic A term used to denote any one of the following: (a) A visual representation of an idea, object, or other factors, shown by means of lines, marks, shapes, and symbols. A still picture, illustration, symbol, shape, or other visual images, or (b) A simple graphic is a graphic equal to line drawings and outlines.

Graphics card A peripheral device that allows a computer to process and display graphics.

H

Handbook A document prepared specifically to provide guidance information used in design, engineering, production, acquisition, and supply management operations. Military handbooks are documents issued within the Department of Defense in accordance with the basic policy of the Defense Standardization Program. Military handbooks are used for the presentation of general information, procedural and technical use data, or design information related to commodities, processes, practices and services. Military handbooks also provides industry with reference material that will serve the standardization program. The use of handbooks as references is optional.

Hard disk A memory storage device using a magnetically coated, rigid disk. An inflexible magnetic disk, with greater storage capacity than a floppy disk, used as a mass storage medium. Also called "fixed disk or drive" and "Winchester disk".

Hardware A term used to denote any one of the following: (a) The physical components and equipment which actually makes up a computer system (everything except the programs or software). Physical equipment or peripheral devices. The mechanical, electrical, or electronic equipment used for processing data. The various devices of a computer system, including the machine itself, printers, disk drives, monitors, MODEMs, and allied accessories such as cables. Hardware is tangible, whereas software is not; (b) The physical components of a system.

HQMC Headquarters Marine Corps

Hz Hertz

I

I/O Input/Output

IBM International Business Machines Corporation

Information resources management (IRM) The planning, budgeting, organizing, directing, training, promoting, controlling and management activities associated with the burden, collection, creation, use and dissemination of information, including the management of information and related resources, such as personnel, funds and information technology.

In-house Actions performed entirely within the given activity, company, or organization, using its own resources, facilities, and expertise.

Interactive Two-way, immediate communication between a computer and a user. It involves the active participation of the user in directing the flow of the computer or video program. Interactive is a system that exchanges information with the viewer, processing the viewer's input in order to generate the appropriate response within the context of the instruction.

Interactive courseware (ICW) A term used to denote any one of the following: (a) A computer program controlled instruction that relies on trainee input to determine the order and pace of instruction delivery. The trainee advances through the sequence of instructional events by making decisions and selections. The instruction branches according to the trainee's responses. (b) A term referring to any type of computerized instruction characterized by the ability of a trainee to respond through an input device. ICW may be an integral part of computer-based instruction (CBI), computer assisted instruction (CAI), and computer-based training (CBT).

Interactive learning Instruction characterized by some kind of interchange taking place between the user and the material. The user learns the instruction through this interchange with the material.

Interactive video Interactive video uses analog and digital video to present instructional material in the ICW environment.

Interactive Multimedia Association (IMA) An association of organizations, institutions, and individuals actively involved in the production and use of interactive technology and optical media systems, and those who provide services to the industry.

Interoperability A term used to denote any one of the following: (a) The ability to interchange hardware components having the same form, fit and function, across hardware platforms, without affecting the functionality of the system, or (b) The ability to have application software operating on heterogeneous hardware/software platforms cooperate in performing some user function.

ISO International Standards Organization

IVD Interactive Videodisc

J

JPEG Joint Photographic Experts Group

JSAG Joint Service Action Group

K

Kilobytes (KB) The standard unit of the memory. A term indicating 1,024 bytes of data storage capacity.

L

LAN Local Area Network

Laser disc Common name for "reflective optical videodisc." Laser Disc is a trade name of Pioneer Electronics for its reflective optical videodisc products.

LtCol Lieutenant Colonel

M

Maj Major

MCCDC Marine Corps Combat and Development Command

MCCTA Marine Corps Computer and Telecommunications Activity

MCI Marine Corps Institute

MCO Marine Corps Order

Megabyte (MB) One million bytes or one thousand kilobytes.

Mgt Management

MHz Megahertz

MIDI Musical Instrument Digital Interface

MIL-HDBK Military Handbook

MIL-STD Military Standard

Military occupational specialty (MOS) A term used to identify a grouping of duty positions possessing such close occupational or functional relationship that an optimal degree of interchangeability among persons so classified exists at any given level of skill.

Military training The instruction provided personnel to develop capability to perform specific military functions and tasks, and to enhance their knowledge of the science and art of war.

MMC Multimedia Contract

MMTR Military Manpower Training Report

MPC Multimedia Personal Computer

MPEG Motion Picture Expert Group

Multimedia Use of more than one medium to convey the content of instruction. Media available for use may include, but need not be limited to: text, programmed instruction, audio and video tapes/discs, slides, film, television, and computers.

N

National Television Standards Committee (NTSC) A term used to denote any one of the following: (a) National Television Standards Committee. A committee of the Electronics Industries Association (EIA) that prepared the standard specifications

approved by the FCC, or (b) An acronym for referring to the American television standards set by the National Television Standards Committee. The American color television standard having 525 scan lines, a field frequency of 60 Hz, a broadcast bandwidth of 4 MHz, line frequency of 15.75 KHz, frame frequency of 1/30 of a second, field frequency of 1/60 of a second, and a color subcarrier frequency of 3.58 MHz.

NIST National Institute for Standards and Technology

NPS Naval Postgraduate School

NTSC National Training Systems Command

O

On-the-job training (OJT) Training in designated job skills provided at the job sites.

Operating system (OS) A set of programs that facilitates computer system operation. A set of programs which control the running of a computer and its peripherals. The fundamental instructions by which a computer can store, process, and retrieve information. Software which controls the execution of computer programs and which may provide scheduling, debugging, input/output control, accounting, compilation, storage assignment, data management, data transfer, and related services.

P

Part-task training device A device that permits selected aspects of a task to be practiced independently of other elements of the task. Its purpose is to provide economical training on certain elements requiring special practice but that are not dependent upon the total equipment.

Personal computer (PC) A microcomputer. A relatively inexpensive, somewhat portable computer for business and home use.

POM Program Objective Memorandum

Portability The capability to run courseware and associated application programs without modification on a delivery system other than the one for which they were originally designed. Also called "transportability".

R

Random Access Memory (RAM) Addressable memory directly controlled by the central processing unit of a computer. That part of a computer's internal memory which can both read (find and display) and write (record) information, and which can be updated or amended by the user. The memory used by the computer in its everyday operations. Memory that is lost when power is removed from a computer. A type of storage on a chip in which data can be written and be read.

S

Simulation A term used to denote any one of the following: (a) Representation of a system, sub-system, situation, or device, with a degree of realism. Training that resembles portions, or sub-tasks, of the actual system operation. A representation of reality or any imitation of reality for training purposes. The representation of the functioning of one system or process by means of the functioning of another. Presentation of a set of relationships or sequence of events illustrating an actual device, situation, or system. A model of a real-world event or device. Carrying out the steps or computations of a model in order to determine what will happen in a given set of circumstances, or (b) A learn-by-doing educational strategy, where the trainee sees the result of a decision or action. Suitable where judgment (not recall) is emphasized.

Software The programs and routines that tell the computer and its peripherals what to do. Any system of instructions that direct computer operation.

Software interface The boundary between two or more software modules, or a protocol that defines how two software modules communicate.

SPA Software Publishing Association

Standard A document that establishes engineering and technical requirements for items, equipment, processes, procedures, practices, and methods that have been adopted as standard. Standards may also establish requirements for selection, application, and

design criteria for materiel. Military standards are documents issued within the Department of Defense in accordance with the basic policy of the Defense Standardization Program.

T

TCA TRADOC Contracting Activity

Touch screen In a program of interactive courseware, the monitor screen acts as an input device which, when touched, branches the program to a developer defined location. Also called "touch sensitive display" and "touch sensitive screen".

TRADOC Training and Doctrine Command

Training effectiveness The training benefit gained in terms of operational readiness. Also, the thoroughness with which training objectives have been achieved, regardless of training efficiency.

Training efficiency The extent to which training resources (including time) are used economically while achieving training effectiveness. Refers to resource investments required to achieve specific training objectives or requirements. Resources may include time, instructor assets, training device assets, equipment assets, and costs. (Training efficiency is directly related to training effectiveness. There can be no efficiency if there is no effectiveness, because effectiveness implies a benefit from the resources invested). See definition for "training effectiveness". Also called "efficiency".

U

Unit training Individual, collective, and joint or combined training conducted at the unit level.

USATSC U.S. Army Training Support Center

USMC United States Marine Corps

V

VDI Virtual Device Interface

VGA Video Graphic Adapter

Video Pictorial images on a monitor produced by sources external to the computer, such as videodisc and videotape and digital video.

Videodisc A generic term used to describe a medium of audiovisual information storage. A thin circular plate composed of translucent layered plastics sandwiching a metal layer on which video, audio, and other information is encoded as a series of shallow microscopic pits along a circular or spiral track for playback.

Virtual Existing or resulting in effect though not in actual fact.

W

WAN Wide Area Network

X

XGA Extended Graphics Adapter

APPENDIX B: DEMOGRAPHICS OF FOCUS GROUPS

Group Number	MOS	Rank	Year Commissioned	Age	Curriculum
1	0402	Maj	1979	38	Information Technology Mgt
1	3002	Capt	1985	29	Information Technology Mgt
1	6002	Capt	1988	34	Information Technology Mgt
1	4002	Capt	1981	37	Computer Science
1	0802	Capt	1981	37	Manpower Mgt
1	0402	Capt	1984	32	Material Mgt
1	7562	Maj	1977	39	National Security Affairs
2	3404	Maj	1978	37	Information Technology Mgt
2	3002	Capt	1985	29	Information Technology Mgt
2	2502	Capt	1984	30	Computer Science
2	0402	Maj	1976	37	Computer Science
2	6002	Capt	1988	32	Computer Science
2	0802	Maj	1980	34	Computer Science
2	0202	Maj	1979	38	National Security Affairs
3	3404	Capt	1986	29	Information Technology Mgt
3	0802	Capt	1985	33	Information Technology Mgt
3	0402	Capt	1986	30	Information Technology Mgt
3	7562	Maj	1980	39	Information Technology Mgt
3	2502	Capt	1983	36	Information Technology Mgt
3	4002	Capt	1987	30	Computer Science
3	1302	Capt	1983	31	Defense Systems Analysis

APPENDIX C: FOCUS GROUP DISCUSSION GUIDE

I. Multimedia Demonstrations

II. Opening Comments

A. Purpose of Focus Group

B. Guidelines for Conduct

C. Individual Introductions

III. Current Implementation of Multimedia in the USMC

A. Does anyone know of existing multimedia or planned multimedia training applications in the USMC?

B. On the basis of my initial research, there is currently very limited use of multimedia for training applications, especially in comparison to the other services, in the USMC. Why do you think that is and what do you perceive as the objections to implementation? Have participants discuss ways objectives can be overcome.

C. If not brought up by the group participants, ask about these objections uncovered during the telephone interview process.

1. Cost
2. Lack of top level support
3. Reluctance to use courseware developed by another service
4. Lack of understanding about capabilities and limitations
5. Reluctance to use training method that is not field oriented, hands on, etc.
6. Lack of in-house assets to develop training applications
7. Uncertainty about using computers vice live instruction

IV. Future Implementation of Multimedia in the USMC

A. Do you think multimedia should be implemented for training applications within the USMC?

B. When applying this technology, should this be limited to formal schools and HQMC approved courseware or can ad hoc training be developed by local commands?

C. What are examples of where you would like to see multimedia training applications implemented and what areas should be avoided?

D. If you wanted to create acceptance for multimedia within the USMC, what approaches should be taken to do this?

V. Serendipitous questions

VI. Closing comments

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